CLAIMS

We claim:

1. A process for reducing sodium chloride concentration in an aqueous sodium chloride solution, comprising

electrolyzing said aqueous sodium chloride solution in a first container, said electrolysis splitting sodium chloride in said aqueous sodium chloride solution producing chloride anions, sodium metal and processed solution, said chloride anions combining producing chlorine gas, said processed solution having a sodium chloride concentration lower than said aqueous sodium chloride solution sodium chloride concentration;

bubbling said chlorine gas from said first container;

collecting said sodium metal on a surface producing sodium amalgam;

removing said sodium metal from said first container; and

removing said processed solution from said first container.

2. The process of Claim 1, further comprising coupling said surface to an air depolarizing fuel cell electrode in a second container containing dilute sodium hydroxide, said coupling anodically dissolving said sodium metal in said dilute sodium hydroxide producing concentrated sodium hydroxide and electrical power.

3. The process of Claim 2, further comprising reacting said concentrated sodium hydroxide with said chlorine gas in a third container producing sodium hypochlorite.

4. The process of Claim 1, said electrolyzing comprising:

applying an electric potential across an anode and a cathode;

contacting said aqueous sodium chloride solution with said anode, said contacting with said anode liberating said chloride anions; and

contacting said sodium metal discharging with said cathode, said cathode comprising said surface.

5. The process of Claim 4, said electric potential supplied by a photovoltaic device in electrical communication with said anode and said cathode.

6. The process of Claim 2, said collecting comprising collecting said sodium metal on a stainless steel belt coated with a material having high hydrogen overpotential producing sodium amalgam.

7. The process of Claim 6, said material having high hydrogen overpotential selected from the group consisting of mercury, tin and lead.

8. The process of Claim 3, further comprising restricting the flow of chloride anions and chlorine gas to said cathode.

9. The process of Claim 8, said restricting comprising disposing a membrane between said anode and said cathode, said membrane inhibiting the flow of said chloride anions and said chlorine gas to said cathode.

10. The process of Claim 9, said selective membrane comprising perfluorosulfonic acid polymer.

11. The process of Claim 8, further comprising moving said stainless steel belt from said first container containing said aqueous sodium chloride solution into said second container containing dilute sodium hydroxide and said fuel cell, said stainless steel belt collecting said sodium metal in said first container, said sodium metal dissolving in said dilute sodium hydroxide in said second container.

12. The process of Claim 11, said moving comprising a recirculating said stainless steel belt from said first container to said second container

13. The process of Claim 12, said recirculating stainless steel belt adapted to continually flow in a repeating route between said first container and said second container.

14. The process of Claim 1, said aqueous sodium chloride solution comprising brine.

15. The process of Claim 5, said photovoltaic device comprising at least one triple junction solar cell.

16. The apparatus of Claim 15, said at least one triple junction solar cell comprising at least one triple junction amorphous silicon solar cell.

17. The process of Claim 4, said anode comprising a RuO_2 coated titanium anode and said cathode comprising a mercury coated stainless steel cathode.

18. The process of Claim 1, said removing said processed solution comprising discharging said processed solution from said first container through an outlet.

19. The process of Claim 16, said processed solution having a sodium chloride concentration of about zero.

20. An apparatus for reducing sodium chloride concentration in an aqueous sodium chloride solution, comprising:

a source of electrical energy;

a first container containing said aqueous sodium chloride solution;

an electrolyzer for electrolyzing said aqueous sodium chloride solution, said electrolyzer in electrical communication with said source of electrical energy, said electrolyzer splitting sodium chloride in said aqueous sodium chloride solution to produce chlorine anions, sodium metal and processed solution, said chlorine anions combining producing chlorine gas, said processed solution having a sodium chloride concentration lower than said aqueous sodium chloride solution sodium chloride concentration; and

a sodium collector for collecting said sodium metal on an surface producing sodium amalgam.

21. The apparatus of Claim 20, further comprising:

a second container containing dilute sodium hydroxide; and

an air depolarizing fuel cell electrode in said second container, said air depolarizing fuel cell electrode coupling to said surface, said coupling dissolving said sodium metal in said dilute sodium hydroxide to produce concentrated sodium hydroxide and electrical power.

22. The apparatus of Claim 21, further comprising:

a third container;

a first conduit for flowing said concentrated sodium hydroxide from said second to said third container; and

a second conduit for feeding said chlorine gas from said first container to said third container, said concentrated sodium hydroxide reacting with said chlorine gas to produce said sodium hypochlorite in said third container.

23. The apparatus of Claim 20, said source of electrical energy comprising a photovoltaic device, said photovoltaic device converting solar energy to electricity.

24. The apparatus of Claim 23, said photovoltaic device comprising at least one triple junction solar cell.

25. The apparatus of Claim 24, said at least one triple junction solar cell comprising at least one triple junction amorphous silicon solar cell.

26. The apparatus of Claim 20, said electrolyzer comprising:

an anode in electrical communication with said source of electrical energy and said anode in contact with said aqueous sodium chloride solution,

a cathode in electrical communication with said source of electrical energy, said source of electrical energy generating an electric potential between said anode and said cathode, said anode liberating chlorine anions, said cathode contacting and collecting said sodium cations, said cathode comprising said surface.

27. The apparatus of Claim 26, said anode comprising a RuO_2 coated titanium anode and said cathode comprising mercury coated stainless steel.

28. The apparatus of Claim 20, said aqueous sodium chloride solution comprising brine.

29. The apparatus of Claim 20, said sodium collector comprising a stainless steel belt amalgamated with a material having a high hydrogen overpotential.

30. The apparatus of Claim 29, said material selected from the group consisting of lead, tin and mercury.

31. The apparatus of Claim 29, said stainless steel belt comprising a recirculating stainless steel belt adapted to flow from said first container to said second container, said recirculating stainless steel belt collecting said sodium metal in said first container, flowing to said second container and contacting said dilute sodium hydroxide in said second container to release said sodium metal.

32. The apparatus of Claim 31, said stainless steel belt comprising a recirculating stainless steel belt adapted to continually flow in a repeating manner between said first container and said second container.

33. The apparatus of Claim 26, further comprising a membrane disposed in said first container between said anode and said cathode, said membrane inhibiting the flow of said chlorine anions and said chlorine gas to said cathode.

34. The apparatus of Claim 33, said selective membrane comprising perfluorosulfonic acid polymer.

35. The apparatus of Claim 20, further comprising an inlet and an outlet, said inlet transferring said aqueous sodium chloride solution into said first container, said outlet discharging said processed solution out of said first container.

36. The apparatus of Claim 20, said processed solution having a sodium chloride concentration of zero.

37. The process of Claim 2, said coated surface comprising a stainless steel belt coated with mercury.